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EXPERIMENTAL ROADS IN THE VICINITY OF WASHINGTON, D. C.

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During the past six years the Department of Agriculture has constructed a series of experimental roads in and near Washington, D. C., including sections of surface-treated macadam and gravel, bituminous macadam, bituminous concrete, cement concrete, and brick. For purposes of inspection and consideration of data regarding the experiments there has developed a need for a circular giving in convenient form the sequence of sections, a summary of the methods of construction and maintenance, and up to date cost records. To supply this needed publication, the following tables have been prepared.

CHEVY CHASE, MONTGOMERY COUNTY, MD.

1911 AND 1912.

Bituminous macadam and surface treatment.—This experimental road begins at the District of Columbia line at Chevy Chase Circle and extends on Connecticut Avenue to Bradley Lane. Limestone was used throughout, and in general, the base course is 5½ inches thick and the wearing course 2½ inches thick.

NOTE.—The bituminous materials used in the experiments are denoted by the following abbreviations:

Coal tar, refined	C. T. ref.	Residual asphaltic petroleum	R. A. P.
Coal tar, crude	C. T. cr.	Residual petroleum	R. P.
Coal-tar preparation	C. T. prep.	Asphaltic petroleum	A. P.
Water-gas tar, refined	W. G. T. ref.	Fluxed native asphalt	F. N. A.
Water-gas-tar preparation	W. G. T. prep.	Native asphalt emulsion	N. A. em.
Oil asphalt	O. A.		

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Penetration experiments, 1911.

Experiment.	Length.	Bituminous material.			Cost of original surfacing per square yard.	Surface treatment.				Cost of surface maintenance per square yard Jan. 1 to Dec. 31, 1916.	Total cost of surfacing per square yard to Dec. 31, 1916.
		Kind.	First application per square yard.	Second application per square yard.		Applied.	Bituminous material.	Quantity per square yard.	Cost per square yard.		
	Feet.		*Gals.*	*Gals.*	*Cents.*			*Gal.*	*Cents.*	*Cent.*	*Cents.*
1	513	C. T. ref.	1.78	0.81	46.18	1914	C. T. cr.	0.316	5.04	0.28	54.57
2	373	...do.[1]...	[1] 1.95	1.02	64.42	....	....	....	....	.64	67.35
3	823	F. N. A..	1.46	.50	64.69	....	....	....	....	.38	66.02
4	823	Gilsonite O. A	1.64	.55	57.18	....	....	....	....	.67	60.85
5	819	O. A	1.69	.56	58.27	....	....	....	....	.53	79.90
6	876	...do.....	1.56	.53	68.22	....	....	....	....	.57	71.08
7A	69	...do.....	1.66	.60	59.96	....	....	....	....	.29	66.03
7B	449	...do.....	1.86	....	54.80	1912	A. P....	.29	7.23		

[1] Over the base course a layer of sand 1 inch thick and 1.18 gallons per square yard of light C. T. ref. was applied.

Surface treatment experiments, 1912.

Experiment.	Length.	Bituminous material.		Screenings per square yard.	Cost of original treatment per square yard.	Retreatment.				Cost of surface maintenance per square yard Jan. 1 to Dec. 31, 1916.	Total cost of surface per square yard to Dec. 31, 1916.
		Kind.	Quantity per square yard.			Applied.	Bituminous material.	Quantity per square yard.	Cost per square yard.		
	Feet.		*Gals.*	*Cu. yd.*	*Cts.*			*Gal.*	*Cts.*	*Cts.*	*Cts.*
8	782	W. G. T. prep. (cold).	0.54	0.014	7.01	1913	W. G. T. ref..	0.25	5.46	....	....
						June, 1916	W. G. T. prep.	.149	6.55	7.92	56.38
9	403	A. P......	.53	.014	9.43	1913	A. P........	.204	5.21	....	....
						1914	.....do......	.209	4.71	....	....
						1915	.....do......	.197	7.5	....	....
						July, 1916	.....do......	.289	8.76	10.24	71.73
10	482	...do[1].....	.476	.011	8.11	1915	.....do......	.172	7.8	....	....
						July, 1916	.....do......	.299	8.90	12.98	100.48
11	201	N. A. em.[2]	3.32	.045	81.51	....	....	......	......	1.56	83.07

[1] Old treatment of R. P. applied in 1912 was removed in October, 1914, and the macadam resurfaced before surface treatment.

[2] Trap screenings and emulsion were mixed to form a wet mortar and spread over the 3-inch layer of No. 2 limestone, then rolled into the voids.

Traffic records kept during the period from January 1 to December 30, 1916, show an average for a 24-hour period of 50 horse-drawn vehicles and 509 motor-driven cars going north and 48 horse-drawn vehicles and 392 motor-driven cars going south.

1912 AND 1913.

Bituminous concrete, cement concrete, oil-cement concrete, bituminous surface treatments on concrete and vitrified brick.—This experimental road begins at Bradley Lane and extends north over Connecticut Avenue to the loop of the Capital Traction Co. tracks at Chevy Chase Lake.

Experiment.	Length.	Description.	Cost of original experiment per square yard.	Cost of maintenance per square yard from Jan. 1 to Dec. 31, 1916.	Total cost of experiment per square yard to Dec. 31, 1916.
	Feet.		*Cents.*	*Cents.*	*Cents.*
1	635	Bituminous concrete (Topeka spec.) 2-inches thick on a 6-inch foundation of 1:3:7 cement concrete	186.62	0.00	186.84
		A. Limestone F. N. A. mix.			
		B. Trap rock F. N. A. mix.			
2	630	Bituminous concrete (D. C. spec.), 2-inches thick on a 6-inch foundation of 1:3:7 cement concrete. Seal coat—0.51 gal. F. N. A. per sq. yd	195.65	0.26	196.45
		A. Limestone, sand, F. N. A. mix.			
		B. Trap rock, sand, F. N. A. mix.			
3	1,840	Cement concrete and oil-cement concrete (same as experiments 4 and 5). Surface treated with bituminous materials	[3] 154.95	[3] 8.10	163.14
		A, B, G, and H. W. G. T. prep., 0.307 gals. per sq. yd	[1] 7.81	....	....
		C, D, E, and F. R. A. P., 0.275 gals per sq. yd	[1] 6.33	....	....
		I and J. A. P., 0.499 gals. per sq. yd	[1] 11.65	....	....
4	[2] 771	Oil-cement concrete 1:1¾:3 with 5 pints R. P. per bag of cement	[3] 150.25	1.02	152.44
		Coarse aggregate—gravel, limestone, or trap rock.			
5	1,339	Cement concrete 1:1¾:3	[3] 142.29	0.28	143.32
		Coarse aggregate: Gravel, limestone, or trap rock.			
6	980	Vitrified brick, with base similar to that in experiments 1 and 2, and 2-inch sand cushion grouted with 1:1 cement-sand grout	258.21	0.08	258.37
		A. and B: Shale, wire-cut lug.			
		C, D, E, F, G, H, I, and L: Shale, repressed.			
		J, K, and M: Fire-clay, repressed.			
		N, Fire-clay, wire-cut lug.			

[1] Cost of surface treatment applied October, 1916. Cost of original concrete is same as in experiments 4 and 5.

[2] Not continuous.

[3] Weighted average price for different sections.

Traffic record kept from January 1 to December 30, 1916, shows an average for a 24-hour period of 21 horse-drawn vehicles and 103 motor-driven cars going north, and 67 horse-drawn vehicles and 373 motor-driven cars going south.

BRADLEY LANE, MONTGOMERY COUNTY, MD.

1915.

Bituminous macadam.—This experimental road begins at Connecticut Avenue and extends to Wisconsin Avenue. It was constructed by the penetration method, using limestone and oil asphalt.

Experiment.	Length.	Oil asphalt per square yard.	Cost of wearing course per square yard.	Re-treatment.			Cost of maintenance per square yard Jan. 1 to Dec. 31, 1916.	Total cost per square yard to Dec. 31, 1916.
				Applied.	R. A. P. per square yard.	Pea gravel per square yard.		
	Feet.	*Gals.*	*Cents.*		*Gal.*	*Cu. yd.*	*Cents.*	*Cents.*
1	3,613.5	2.08	32.84	July, 1916	0.195	0.011	7.29	40.48
[1] 2	200	[1] 1.83	39.42					

[1] In this experiment from 33 to 50 per cent by volume of sand was added to the oil asphalt before pouring the penetration course. Since re-treatment the whole project has been considered as one experiment.

The traffic record kept from January 1 to December 30, 1916, shows an average for a 24-hour period of 26 horse-drawn wagons and 192 motor-driven cars going east and 29 horse-drawn wagons and 220 motor-driven cars going west.

ROCKVILLE PIKE, MONTGOMERY COUNTY, MD..

1913.

Tars and oils—Surface treatment on waterbound macadam.—This experimental road begins at the District of Columbia line and extends over what is known as the Rockville Pike to the corporate limits of Rockville, Md., a distance of approximately 9 miles. The original bituminous materials were applied by a horse-drawn distributor equipped with a gasoline pump; the south half of each experiment was covered with trap-rock chips, the north half with pea gravel. In subsequent treatments the same type of bituminous material as applied originally was used.

Experiment.	Length.	Bituminous material.		Cost of original surface treatment with gravel per square yard.	Retreatments.			Cost per square yard of surface maintenance Jan. 1 to Dec. 31, 1916.	Total cost per square yard of bituminous surface to Dec. 31, 1916.
		Kind.	Quantity per square yard.		Applied.	Bitumen per square yard.	Cost of surface treatment per square yard.		
	Feet.		*Gal.*	*Cents.*		*Gal.*	*Cents.*	*Cents.*	*Cents.*
1	[1] 9,060	C. T. ref. (hot)	0.531	10.93	1915	0.425	10.9		
					Oct., 1916 [2]	.33	6.80	5.26	32.96
2	[1] 4,425	W. G. T. ref. (cold)	.438	8.14	1914	.294	5.84		
					July, 1916	.157	6.33	6.83	25.72
3	7,400	A. P. (cold)	.470	7.64	1914	.176	3.87		
					1915	.165	7.00		
					June, 1916	.154	5.95	6.87	27.29
4	7,100	R. A. P. (hot)	.473	9.87				2.40	17.61
5	6,775	do.	.496	9.89				2.21	17.53
6	6,325	W. G. T. prep. (hot).	.531	10.30	1915	.474	11.1	1.34	28.87
7	6,689	A. P. (cold)	.502	8.62	1915	.204	5.8		
					July, 1916	.16	6.31	6.87	27.28

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[1] In July, 1915, the original length of experiment (6,105 ft.) was increased by 2,955 feet of the original experiment 2, which had been re-treated in 1914.

[2] Only that part north of Bradley Lane was re-treated.

The traffic record kept from January 1 to December 31, 1916, on the section of road between experiments 2 and 7 shows an average for a 24-hour period of 28 horse-drawn wagons and 233 motor-driven cars going north and 24 horse-drawn wagons and 242 motor-driven cars going south.

FALLS ROAD, MONTGOMERY COUNTY, MD.

1915.

Bituminous surface treatments on waterbound macadam.—This experimental road begins at the city limits of Rockville and extends in a southwesterly direction to Potomac, Md. The bituminous materials were applied by means of an automobile pressure distributor and covered with pea gravel distributed at the approximate rate of 0.150 cubic yards per square yard.

Experiment.	Length.	Bituminous material.		Cost of original treatment per square yard.	Retreatment. (Same bituminous material as before.)			Total cost of maintenance per square yard Jan. 1 to Dec. 31, 1916.	Total cost of experiments per square yard. to Dec. 31, 1916.
		Kind.	Quantity per square yard.		Applied.	Bituminous material per square yard.	Sand or gravel per square yard.		
	Feet.		*Gal.*	*Cents.*		*Gal.*	*Cu. yd.*	*Cents.*	*Cents.*
1	4,575	A. P. (cold).......	0.53	7.77	Oct., 1916.......	0.231	0.0114	6.25	14.02
2	4,386	R. A. P. (hot).. ..	.74	12.11	....	....	....	1.07	13.18
3	7,941	C. T. prep. (cold).	.42	8.48	Nov., 1916.......	.328	.0115	9.33	17.81
4	5,718	W.G.T.ref. (cold).	.54	9.63	....	....	....	.10	9.73
5	5,880	C. T. ref. (hot)....	.60	10.21	....	....	....	.01	10.22

The traffic record kept from April 10 to December 31, 1916, shows an average for a 15-hour period of 50 horse-drawn wagons and 38 motor-driven cars going southwest and 51 horse-drawn wagons and 38 motor-driven cars going northeast.

WASHINGTON, D. C.

1912.

Surface treatments on a water-bound macadam.—These experimental sections are located on the roads traversing the grounds of the Department of Agriculture, Washington, D. C. The bituminous materials were applied originally by a horse-drawn pressure-pump distributor and covered with washed pea gravel. Supplementary treatments were applied by hand and covered with torpedo sand.

Experiment.	Length.	Bituminous material.		Cost of original treatment per square yard.	Re-treatments.			Cost per square yard of retreatment and annual repairs.	Total cost per square yard of bituminous surface to Dec. 31, 1916.
		Kind.	Quantity per square yard.		Applied.	Bituminous material.	Quantity of bituminous material per square yard.		
	Feet.		*Gal.*	*Cents.*			*Gal.*	*Cents.*	*Cents.*
1	766	W. G. T. prep.	0.430	7.00	1914.........	W. G. T. prep.	0.177	4.06	15.84
					Sept., 1916..	.....do........	.138	4.78	....
2	616	A. P.........	.411	7.57	1913.........	A. P.[1]........	.10	2.33	22.44
					1914.........	.....do........	.137	3.52	....
					1915.........	.....do........	.044	4.60	....
					Sept., 1916..	.....do........	.152	4.42	....
3	397	R. P..........	.425	8.94	1913.........	R. P.[1]........	.10	2.92	27.52
					1914.........	.....do........	.184	4.22	....
					1915.........	A. P...........	.229	6.80	....
					Oct., 1916...	.....do........	.113	4.64	....
4	743	A. P.........	.265	5.67	1913.........	A. P.[1]........	.10	2.08	19.03
					1914.........	.....do........	.145	3.38	....
					1915.........	.....do........	.150	3.26	....
					Oct., 1916...	.....do........	.113	4.64	....

[1] Applied only on central portion of roadway.

1915.

Bituminous concrete on a 6-inch foundation of 1:3:7 cement concrete.—These experiments are located on the two wing drives leading from the sheet-asphalt pavement in front of the main building of the United States Department of Agriculture to the sheet-asphalt plaza in the rear.

Bituminous concrete specification.	Location on each drive.	Total length.	Seal coat O. A. per square yard.	Finish.	Cost of original experiment per square yard.	Cost of maintenance to Dec. 31, 1916.	Total cost per square yard to Dec. 31, 1916.
		Feet.	*Gal.*		*Cents.*	*Cent.*	*Cents.*
Topeka	North	140		Portland cement	115.54	0.0	115.54
District of Columbia	South	140	0.3	Stone chips	121.04	.0	121.04

No traffic census has been taken on this improvement.

MOUNT VERNON AVENUE ROAD, ALEXANDRIA COUNTY, VA.

1915.

Bituminous macadam, bituminous concrete, bituminous gravel concrete.—Experiments are numbered consecutively toward Alexandria from the north end of the project at the Military Road near the Arlington Cemetery. The base is as follows:

Experiments 1 to 12, inclusive, new gravel.
Experiments 13 to 16, inclusive, reshaped bituminous macadam.
Experiments 17 to 20, inclusive, reshaped water-bound macadam.

Experiment.	Length.	Stone.	Method.	Bituminous material.		Cost of original surfacing per square yard.	Surface treatment, 1916.				Total cost of maintenance per square yard Jan. 1 to Dec. 31, 1916.	Total cost of surfacing per square yard to Dec. 31, 1916.
				Kind.	Quantity per square yard.		Applied.	Bituminous material.	Quantity per square yard.	Cost per square yard.		
	Feet.				*Gals.*	*Cts.*			*Gal.*	*Cents.*	*Cents.*	*Cents.*
1	661	Sandstone	Penetration.	F. N. A.	2.17	80.13					7.36	87.49
2	1,300	...do	...do	O. A.	2.04	66.43					2.08	68.51
3	1,010	...do	Mixing	F. N. A.	2.14	88.98	March	W.G.T.ref.	0.419	8.49	11.90	100.88
4	1,000	...do	...do	O. A.	2.10	74.27	...do	...do	.488	7.26	10.06	84.33
5	1,235	Gneiss	Penetration.	F. N. A.	2.03	47.74					2.95	50.69
6	800	...do	...do	O. A.	2.12	36.85					.52	37.37
7	1,333	...do	Mixing	...do	2.10	45.57					.89	46.46
8	587	...do	...do	F. N. A.	2.10	57.81					1.41	59.22
9	1,095	Pit gravel.	...do	O. A.	2.46	33.54					2.94	36.48
10	2,860	...do	...do	F. N. A.	2.02	43.74					2.10	45.84
11	885	...do	...do	C. T. ref.	2.29	41.62					2.42	44.04
12	2,605	...do	...do	O. A.	2.46	33.54					2.94	36.48
13	950	Trap	Penetration.	...do	2.03	48.41					.92	49.33
14	1,000	...do	...do	F. N. A.	2.02	58.98					1.61	60.59
15	980	...do	Mixing	...do	2.07	65.77					.18	65.95
16	920	...do	...do	O. A.	2.00	52.66					3.24	55.90
17	800	Granite	Penetration.	F. N. A.	2.12	63.04	June	R. A. P.	.342	10.9	14.02	77.06
18	889	...do	...do	O. A.	1.92	48.29	...do	...do	.346	9.89	14.57	62.86
19	982	...do	Mixing	...do	2.31	54.26	...do	...do	.348	9.25	11.95	66.21
20	1,040	...do	...do	F. N. A.	2.25	67.73	...do	...do	.335	8.93	10.59	78.32

The traffic record kept from April 8 to December 31, 1916, on the sections north of the Russell Road shows an average for a 16-hour period of 13 horse-drawn wagons and 577 motor-driven cars going north and 12 horse-drawn wagons and 430 motor-driven cars going south.

RUSSELL ROAD, ALEXANDRIA COUNTY, VA.

1916.

Bituminous macadam and bituminous gravel.—This experimental road begins at a place due south of the Four-Mile Run on the Mount Vernon Avenue experimental road and extends in a southerly direction to the corporate limits of Alexandria, Va. All experiments were constructed on a compacted gravel base.

Experiment.	Length.	Method.	Wearing course stone.	First application.		Second application.		Covering material.	Cost of original surfacing per square yard.
				Bituminous material.	Quantity per square yard.	Bituminous material.	Quantity per square yard.		
	Feet.				*Gals.*		*Gal.*		*Cents.*
1	1,600	Penetration..	Trap.......	W. G. T. prep.	1.6	W. G. T. prep.	0.6	Trap....	46.61
2	1,810	.....do.......	.....do.....	.....do.....	1.63	O. A.......	.62	...do....	48.59
3	1,864	.....do.......	.....do.....	C. T. ref....	1.5	C. T. ref....	.5	...do....	47.55
4	1,800	.....do.......	.....do.....	.....do.....	1.40	O. A.......	.62	...do....	48.78
5	500	Penetration (tar-sand grout).[2]	Screened gravel.	W. G. T. prep.	1.47	W. G. T. prep.	.60	Pea gravel.	40.21
6	506	Penetration..	.....do.....	O. A.......	1.6	O. A.......	.6	...do....	42.58
7	300	Surface treatment.	Gravel[1]....	R. A. P.....	.68	R. A. P.....	55	Pea gravel and sand.	33.75
8	200	.....do.......	.....do.....	.....do.....	.693	....	....	...do....	

[1] A mixture of pit-run and ¾-inch screened gravel.

[2] For the first 91 feet a mixture of tar and 30 per cent sand was poured; on the remainder of the experiment sand was distributed to fill the voids after the tar had been applied to the wearing course.

Traffic census taken after the completion of the road shows from June to December, 1916, an average for a 16-hour period of 2 horse-drawn vehicles and 104 motor-driven cars going north and 3 horse-drawn vehicles and 107 motor-driven cars going south.

ALEXANDRIA-GUM SPRING ROAD, FAIRFAX COUNTY, VA.

1916.

Bituminous gravel concrete and soil-asphalt surface on an old gravel road.—This experimental road begins at Hunting Creek bridge, south of Alexandria, and extends over the Alexandria-Accotink road to Gum Spring.

Experiment.	Length.	Surface.	Proportions of mix.	Seal coat.			Cost of original surfacing per square yard.
				Bitumen.	Quantity per square yard.	Covering material.	
	Feet.				*Gal.*		*Cents.*
1	24,500	Bituminous concrete	470 pounds coarse aggregate [1]	O. A.	0.33	(2)	49.50
			335 pounds fine aggregate				
			34 pounds limestone dust				
			53 pounds O. A.				
2	600	Soil-asphalt	560 pounds soil				
			100 pounds O. A.				69.87
			17 gallons water				

[1] Pit-run gravel was crushed and separated on a ¼-inch screen to secure coarse and fine aggregate.
[2] Pea gravel.

Traffic census has not been taken since the improvement.

MOUNT VERNON ROAD, FAIRFAX COUNTY, VA.

1916.

Bituminous surface treatment on a new gravel road: This experimental road begins at Gum Spring and extends in a southerly direction to the Mount Vernon estate. Bituminous materials were applied by means of an automobile pressure distributor and covered with clay gravel.

Experiment.	Length.	Method.	Bituminous material.		Cost of original treatment per square yard.
			Kind.	Quantity per square yard.	
	Feet.			*Gal.*	*Cents.*
1	2,355	1 cold application	C. T. prep	0.49	8.28
2	6,140	1 hot application	R. A. P	.53	8.82
3	2,355	2 applications:			
		(1) cold	C. T. prep	.35	16.20
		(2) hot	C. T. ref	.50	

Traffic census has not been taken since the improvement.

Details of methods of construction and maintenance, materials and costs are given in the annual progress reports of experimental roads as follows:

1911. Office of Public Roads Circular No. 98.
1912. Office of Public Roads Circular No. 99.
1913. U. S. Department of Agriculture Bulletin No. 105.
1914. U. S. Department of Agriculture Bulletin No. 257.
1915. U. S. Department of Agriculture Bulletin No. 407.
1916. U. S. Department of Agriculture Bulletin No. 586.

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